Claims

We claim:

1. An isolated boost converter for driving an output load, comprising:

an input voltage source;

a boost inductor connected in series with the input voltage source;

a storage capacitor which receives energy from the input voltage source;

a transformer including a primary winding and secondary winding;

first and second switches that couple the storage capacitor to the primary winding of the transformer;

an output filter coupled to the output load;

a rectifier coupling the secondary winding of the transformer to the output filter; and

a switch control circuit to simultaneously open and close the first and second switches.

2. An isolated boost converter as in Claim 1 further comprising a plurality of diodes, wherein the diodes provide a current path for the current of the boost inductor, when the first and second switches are open, and provide decoupling of the primary winding of the transformer, therby allowing a magnetic core of the transformer to reset

3. An isolated boost converter as in Claim 2, wherein the diodes clamp parasitic ringing across the primary winding of the transformer.

4. An isolated boost converter as in Claim 1, wherein when the first and second switches are closed, the storage capacitor is coupled across the primary winding of the transformer, thereby transferring energy stored in the storage capacitor to the output load, while energy in the boost inductor is increased, and wherein, when the first and second switches are open, the energy stored in the boost inductor is transferred to the storage capacitor.

5. An isolated boost converter as in Claim 1, wherein the output filter comprises a filter capacitor.

6. An isolated boost converter as in Claim 1, wherein the output filter comprises a filter inductor and a capacitor.

7. An isolated boost converter as in Claim 1, wherein the input voltage source comprises a direct current (DC) source.

8. An isolated boost converter as in Claim 1, wherein the input voltage source comprises a rectified AC line voltage.

9. An isolated boost converter as in Claim 1, wherein the switch control circuit simultaneously turns on and off the first and second switches.

10. An isolated boost converter as in Claim 9, wherein the switch control circuit turns on and off the first and second switches at a predetermined frequency.

11. An isolated boost converter as in Claim 1, wherein the switch control circuit simultaneously turns on and off the first and second switches at a variable frequency.

12. An isolated boost converter as in Claim 1, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing and reference circuit to control the voltage across the output load.

13. An isolated boost converter as in Claim 1, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing and reference circuits to control the current of the boost inductor.

14. An isolated boost converter as in Claim 1, wherein the current of the boost inductor is maintained during an entire switching cycle.

15. An isolated boost converter as in Claim 1, wherein the current of the boost inductor is zero during a portion of a switching cycle.

16. An isolated boost converter as in Claim 1, further comprising a snubber circuit.

17. An isolated boost converter for driving an output load, comprising:

a first switch and second switch, each having a first and second terminal;

a first and second diode, the first and second diode each including an anode terminal and a cathode terminal, the anode and the cathode terminal of the first diode being connected to the first terminals of the second and first switches, respectively, and the anode and cathode terminal of the second diode connected to the second terminals of the second and first switches, respectively;

a storage capacitor that receives energy from the input voltage source, the storage capacitor being connected between the cathode terminal of the first diode and the anode terminal of the second diode;

a transformer including a primary winding and a secondary winding, the primary winding including a first terminal and a second terminal, the first terminal of the primary winding being connected to the cathode terminal of the second diode;

a third diode having an anode terminal and a cathode terminal, the anode terminal being connected to the second terminal of the primary winding and the cathode terminal being connected to the first terminal of the second switch;

a fourth diode having an anode terminal and a cathode terminal, the anode terminal connected to the anode terminal of the second diode and the cathode terminal of the fourth diode connected to the second terminal of the primary winding of the transformer;

an input voltage source connected in series with a boost inductor, the series connection of the input voltage source and the boost inductor being coupled between the anode terminal of the first diode and the second terminal of the first switch;

an output filter coupled to the output load;

a rectifier coupling the secondary winding of the transformer to the output filter; and

switch control circuit that simultaneously opens and closes the first and second switches.

18. An isolated boost converter as in Claim 17, wherein when the first and second switches are closed, the storage capacitor is coupled across the primary winding of the transformer, while energy in the boost inductor is being increased, and wherein when the first and second switches are open, the energy stored in the boost inductor is transferred to the capacitor.

19. An isolated boost converter as in Claim 17, wherein the output filter comprises a filter capacitor.

20. An isolated boost converter as in Claim 17, wherein the output filter comprises a filter inductor and a capacitor.

21. An isolated boost converter as in Claim 17, wherein the input voltage source comprises a direct current (DC) source.

22. An isolated boost converter as in Claim 17, wherein the input voltage source comprises a rectified AC line voltage.

23. An isolated boost converter as in Claim 17, wherein the switch control circuit simultaneously turns on and off the first and second switches at a constant frequency.

24. An isolated boost converter as in Claim 17, wherein the switch control circuit simultaneously turns on and off the first and second switches at a variable frequency.

25. An isolated boost converter as in Claim 17, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing circuit and the reference circuit to control the voltage across the output load.

26. An isolated boost converter as in Claim 17, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing circuit and the reference circuit to control the current of the boost inductor.

27. An isolated boost converter as in Claim 17, wherein the current of the boost inductor is maintained during an entire switching cycle.

28. An isolated boost converter as in Claim 17, wherein the current of the boost inductor is zero during a portion of a switching cycle.

29. An isolated boost converter as in Claim 17, further comprising a snubber circuit.

30. An isolated boost converter for driving an output load, comprising:

an input voltage source connected in series with a boost inductor;

a capacitor that receives energy from the input voltage source;

a transformer having a primary winding and secondary winding;

first, second, and third switches coupling the capacitor to the primary winding of the transformer;

an output filter coupled to the output load;

a rectifier coupling the secondary winding of the transformer to the output filter;

a switch control circuit to periodically open and close the first, second, and third switches.

31. An isolated boost converter as in Claim 30, further comprising a plurality of diodes, wherein the diodes provide a current path for the current of the boost inductor when the first and second switches are open, and wherein the diodes further provides decoupling of the primary winding of the transformer to allow a magnetic core of the transformer to reset.

32. An isolated boost converter as in Claim 30, wherein the diodes clamp parasitic ringing across the primary winding.

33. An isolated boost converter as in Claim 30, wherein the third switch is closed substantially before the first and second switches are simultaneously closed and wherein the third switch is open before the first and second switches are simultaneously open.

34. An isolated boost converter as in Claim 33, wherein the third switch is closed, energy stored in the boost inductor is transferred to the output load and the capacitor, and when the first and second switches are closed, energy stored in the capacitor is transferred to the output load, while energy in the boost inductor connected is being increased, and when the first, second, and third switches are open, the energy stored in the boost inductor is transferred to the capacitor.

35. An isolated boost converter as in Claim 30, further comprising a blocking capacitor in series with the primary winding of the transformer.

36. An isolated boost converter as in Claim 30, wherein the third switch comprises an antiparallel diode.

37. An isolated boost converter as in Claim 30, wherein the output filter comprises a filter capacitor.

38. An isolated boost converter as in Claim 30, wherein the output filter comprises a filter inductor and a capacitor.

39. An isolated boost converter as in Claim 30, wherein the input voltage source comprises a direct current (DC) source.

40. An isolated boost converter as in Claim 30, wherein the input voltage source comprises a rectified ac line voltage.

41. An isolated boost converter as in Claim 30, wherein the switch control circuit simultaneously turns on and off the first, second, and third switches at a constant frequency.

42. An isolated boost converter as in Claim 30, wherein the switch control circuit simultaneously turns on and off the first, second, and third switches at a variable frequency.

43. An isolated boost converter as in Claim 30, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing circuit and the reference circuit to control the voltage across the output load.

44. An isolated boost converter as in Claim 30, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing circuit and the reference circuit to control the current of the boost inductor.

45. An isolated boost converter as in Claim 30, wherein the current of the boost inductor is maintained during an entire switching cycle.

46. An isolated boost converter as in Claim 30, wherein the current of the boost inductor is zero during a portion of a switching cycle.

47. An isolated boost converter as in Claim 30, further comprising a snubber circuit.

48. An isolated boost converter for driving an output load, comprising:

a first switch and a second switch each having a first terminal and second terminal;

a first diode and second diode, each including an anode terminal and a cathode terminal, the anode terminal and cathode terminal of the first diode being connected to the first terminals of the first and second switches, respectively, and the anode and cathode terminal of the second diode being connected to the second terminals of the first and second switches, respectively;

a capacitor that receives energy from the input voltage source, the capacitor being connected between the cathode terminal of the first diode and the anode terminal of the second diode;

a transformer having a primary winding and a secondary winding, the primary winding having a first terminal and a second terminal; the first terminal of the primary winding being connected to the anode terminal of the first diode;

a third switch having a first and second terminal, the first terminal of the third switch being connected to the second terminal of the primary winding and the second terminal of the third switch connected to the second terminal of the second switch;

a third diode having an anode terminal and cathode terminal, the anode terminal being connected to the first terminal of the third switch and the cathode terminal of the third diode connected to the first terminal of the second switch;

a boost inductor;

an input voltage source connected in series with the boost inductor, the series connection of the input source and the boost inductor coupled between the anode terminal of the first diode and the second terminal of the second switch;

an output filter coupled to the output load;

a rectifier coupling the secondary winding of the transformer to the output filter;

a switch control circuit to periodically open and close the first, second, and third switches.

49. An isolated boost converter as in Claim 48, wherein the third switch is closed substantially before the first and second switches are closed and wherein the third switch is open before the first and second switches are open.

50. An isolated boost converter as in Claim 48, wherein the third switch is closed after the first and second switches are closed and wherein the third switch is open after the first and second switches are open.

51. An isolated boost converter as in Claim 48, wherein when the third switching is closed, energy stored in the boost inductor is transferred to the output load and the capacitor, and when the first and second switches are closed, energy stored in the capacitor is transferred to the output load, while energy in the boost inductor is being increased, and when the first, second, and third switches are open the energy stored in the boost inductor is transferred to the capacitor.

52. An isolated boost converter as in Claim 48, further comprising a blocking capacitor in series with the primary winding of the transformer.

53. An isolated boost converter as in Claim 48, wherein the third switch comprises an antiparallel diode coupled across the first and second terminal of the third switch.

54. An isolated boost converter as in Claim 48, wherein the output filter comprises a filter capacitor.

55. An isolated boost converter as in Claim 48, wherein the output filter comprises a filter inductor and a capacitor.

56. An isolated boost converter as in Claim 48, wherein the input voltage source comprises a direct current (DC) source.

57. An isolated boost converter as in Claim 48 wherein the input voltage source comprises a rectified ac line voltage.

58. An isolated boost converter as in Claim 48, wherein the switch control circuit turns on and off the first, second, and third switches at a constant frequency.

59. An isolated boost converter as in Claim 48, wherein the switch control circuit simultaneously turns on and off the first, second, and third switches at a variable frequency.

60. An isolated boost converter as in Claim 48, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing circuit and the reference circuit to control the voltage across the output load.

61. An isolated boost converter as in Claim 48, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing circuit and the reference circuit to control the current of the boost inductor.

62. An isolated boost converter as in Claim 48, wherein the current of the boost inductor is maintained during an entire switching cycle.

63. An isolated boost converter as in Claim 48, wherein the current of the boost inductor is zero during a portion of a switching cycle.

64. An isolated boost converter as in Claim 48, further comprising a snubber circuit.

65. An isolated boost converter for driving an output load, comprising:

an AC input voltage source;

a boost inductor connected in series with the AC input voltage source;

a capacitor storing energy from the AC input voltage source;

a transformer having a primary winding and a secondary winding;

first, second, third, fourth, fifth, and sixth switches, coupling the capacitor and the boost inductor to the primary winding of the transformer;

an output filter coupled to the output load;

a rectifier coupling the secondary winding of the transformer to the output filter;

a switch control circuit to periodically open and close the first, second, and third switches during each positive half cycles of the ac input voltage

source and to periodically open and close fourth, fifth, and sixth switches during each negative cycle of the AC input voltage source.

66. An isolated boost converter as in Claim 65, wherein the third switch is closed before the first and second switches are closed and wherein the third switch is open before the first and second switches are open.

67. An isolated boost converter as in Claim 65, wherein the sixth switch is closed before the fourth and fifth switch are simultaneously closed and wherein the sixth switch is open before the fourth and fifth switches are open.

68. An isolated boost converter as in Claim 65, wherein the third switch is closed after the first and second switches are closed and wherein the third switch is open after the first and second switches are open.

69. An isolated boost converter as in Claim 65, wherein the sixth switch is closed after the fourth and fifth switches are simultaneously closed and wherein the sixth switch is open after the fourth and fifth switches are simultaneously open.

70. An isolated boost converter as in Claim 65, wherein when the third switch is closed, energy stored in the boost inductor is transferred to the output load and the capacitor, and when the first and second switches are closed, energy stored in the capacitor is transferred to the output load, while energy in the boost inductor is being increased, and wherein when the first, second, and third switches are open, the energy stored in the boost inductor is transferred to the capacitor.

71. An isolated boost converter as in Claim 65, wherein when the sixth switch is closed, energy stored in the boost inductor is transferred to the output load and the capacitor, and when the fourth and fifth switches are closed, energy stored in the capacitor is transferred to the output load, while energy in the boost inductor is being increased, and wherein when the fourth, fifth, and sixth switches are open, the energy stored in the boost inductor is transferred to the capacitor.

72. An isolated boost converter as in Claim 65, further comprising a blocking capacitor in series with the primary winding of the transformer.

73. An isolated boost converter as in Claim 65, wherein the first, second, third, fourth, fifth, and sixth switches each comprise an antiparallel diode.

74. An isolated boost converter as in Claim 65, wherein the output filter comprises a filter capacitor.

75. An isolated boost converter as in Claim 65, wherein the output filter comprises a filter inductor and a capacitor.

76. An isolated boost converter as in Claim 65, wherein the switch control circuit simultaneously turns on and off the first, second, and third switches at a constant frequency.

77. An isolated boost converter as in Claim 65, wherein the switch control circuit simultaneously turns on and off the first, second, and third switches at a variable frequency.

78. An isolated boost converter as in Claim 65, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing circuit and the reference circuit to control the voltage across the output load.

79. An isolated boost converter as in Claim 65, wherein the switch control circuit comprises a sensing circuit and a reference circuit, and wherein the switch control circuit responds to the sensing circuit and the reference circuit to control the current of the boost inductor.

80. An isolated boost converter as in Claim 65, wherein the current of the boost inductor is maintained during an entire switching cycle.

81. An isolated boost converter as in Claim 65, wherein the current of the boost inductor is zero during a portion of a switching cycle.

82. An isolated boost converter as in Claim 65, further comprising a snubber circuit.